KS-20425 AMPLIFIER SYSTEM

DESCRIPTION

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1. GENERAL

1.01 The KS-20425 L1 (Manufacture Discontinued) Amplifier System (Fig. 1 and 2) and the KS-20425 L2 Amplifier System (Fig. 3 and 4) are used to provide equalization and amplification for 5- and 8-kHz local program circuits utilizing nonloaded single or multigauge cables. The circuit is primarily intended to be used with ED-97065-30 distributing resistor panels for distributing musical programs to as many as 270 subscribers. Idle circuit terminations are not necessary when the installation serves less than 270 subscribers. Further detailed information concerning the KS-20425 Amplifier System may be found in SD- and CD-99528-01.

1.02 This section is reissued to add information on the KS-20425 L2 Amplifier System and to change Fig. 3 to 5 and to add new Fig. 3, 4, and 6. Since this reissue covers a general revision, arrows ordinarily used to indicate changes have been omitted.

1.03 The KS-20425 Amplifier System consists of an equalizer, a solid-state distribution amplifier, a solid-state input monitoring amplifier (L2 only), a power supply, and a jack field. The entire assembly is equipped for mounting on 19-inch relay racks.

1.04 The line equalizer is an adjustable shunt-type equalizing network which provides equalization for the incoming nonloaded cable sections to either 5 or 8 kHz. Either of these two frequency limits can be selected by use of a rotary selector switch. A second rotary switch allows the equalizing network to be switched to either the line (primary) or drop (secondary) side of the input transformer.

1.05 The solid-state distribution amplifier consists of an input transformer, a gain control, a 5-stage transistor amplifier, a twin jack for output monitoring, a power supply, an on-off switch, and two terminal boards. The input transformer can be strapped to provide an input impedance of either 150 or 600 ohms and is intended to work from a matched source impedance. The gain control is a screwdriver operated potentiometer. The 5-stage transistor amplifier employs silicon transistors exculsively and utilizes two temperature compensation networks to ensure stable operation over a broad ambient temperature range. The power output stage of the amplifier is a quasi-complementary symmetry circuit, biased class B.

1.06 The distribution amplifier of the KS-20425 L1 is not internally referenced to chassis or office ground but is allowed to float. To avoid crosstalk, it is necessary for the amplifier to be well balanced in impedance and output voltage with respect to ground. In order to provide a balanced output voltage, the KS-20425 L1 amplifier must be provided externally with two equal resistors, one from the Tip side and one from the Ring side to the frame ground.

1.07 Since output impedance of the distribution amplifier is only 0.05 ohm, impedance balance is provided by the pair of 75-ohm building-out resistors. This resistance is provided between the amplifier and the subscriber line by the distributing resistor panels.

1.08 Paragraphs 1.06 and 1.07 also apply to the L2 except the balance resistors to office ground are provided internally.

1.09 The output monitoring jacks provide approximately −15 VU for monitoring the amplifier output with 600-ohm headphones. The power supply operates from 115 Vac and provides the necessary dc voltages for the distribution amplifier and the L2 monitoring amplifier. When the amplifier is fully loaded (delivering musical program at +8 VU to 270 subscribers), the power supply draws approximately 40 watts of ac line

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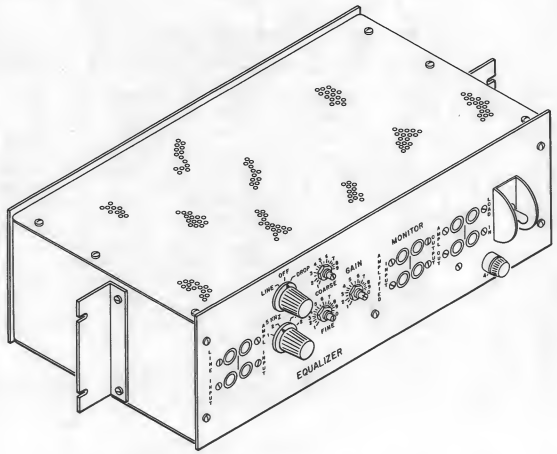

Fig. 1—KS-20425 L1 (Manufacture Discontinued) Amplifier System—Front View

power. The on-off switch is a DPST switch connected into the 115-volt line. It is provided with a guard to prevent inadvertent operation. The two terminal boards provide a total of 20 screw-type terminals for internal strapping options and external connections.

1.10 The input monitoring amplifier (L2 only) consists of a 2-stage transistor amplifier and a twin jack for headphone monitoring. The 2-stage amplifier is a bridging amplifier with its input connected across the output of the gain control of the distribution amplifier. These two stages provide the same total voltage gain as the distribution amplifier so that bridging VU meters connected to the outputs of the amplifiers will read approximately the same under normal operating conditions. Unequal readings indicate a malfunction within the distribution amplifier, whereas equal readings which are above or below +8 VU indicate a faulty gain setting or a faulty input. The input monitoring jacks are connected to the output of the input monitoring amplifier and provide approximately −15 VU for 600-ohm headphone monitoring of the amplified input signal.

1.11 The jack field consists of six twin jacks. These jacks provide access to the line input, amplifier input, distribution amplifier output, load amplified input monitor (L2 only), and distribution amplifier output monitor. All circuits are normalled through the jacks so that no patching is required. External connections and strapping options are facilitated by two screw-type terminal strips located on the rear of the unit.

2. CIRCUIT DESCRIPTION

EQUALIZER CIRCUIT

2.01 The equalizer circuit shown in Fig. 5 and 6 consists of a variable RLC network and two rotary switches. The RLC network is composed of two variable resistors, R1 and R2, in series with the parallel combination of selected inductance and

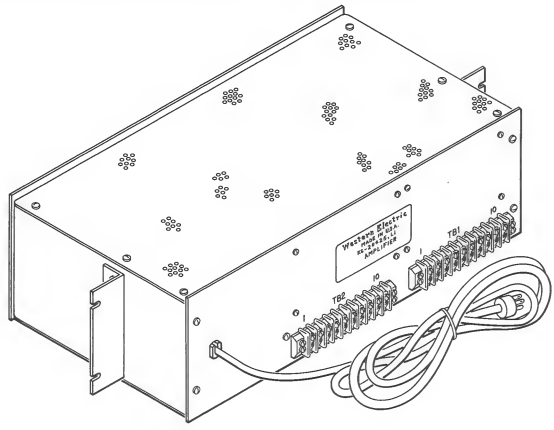

Fig. 2—KS-20425 L1 (Manufacture Discontinued) Amplifier System—Rear View

capacitance. R1 and R2 settings determine the low-frequency insertion loss of the equalizer. The inductance and capacitance values are selected by switch S2. The switch has four positions, two for 5-kHz equalization and two for 8-kHz equalization. The positions designated No. 2 select a lower inductance tap than those designated No. 1 and are typically used to equalize higher-loss lines. The second switch, S3, allows the RLC network to be switched between the line and drop side of input transformer T2. There is no essential difference between line and drop-side operation unless the input transformer is strapped for 150 ohms (Z wiring). S3 also provides an OFF position which disconnects the RLC network from the transmission path.

DISTRIBUTION AMPLIFIER CIRCUIT

2.02 The distribution amplifier circuit shown in Fig. 5 and 6 consists of an input transformer, a gain control, and a power amplifier circuit. The input to the distribution amplifier is applied through the normalled jacks, J1 and J2, to the primary of the input transformer, T2. The 600-ohm gain control, R3, is connected across the secondary of T2 and is shunted by capacitor, C5. The purpose of C5 is to attenuate radio frequency interference which might be present on the incoming line.

2.03 The center tap of the gain control is connected to the inputs of both the power amplifier and the input monitoring amplifier. These amplifiers provide input impedances of 17,000 ohms and 49,000 ohms, respectively, so that the shunting effect on the gain control is negligible. This ensures that the impedance presented to the secondary of T2 is essentially 600 ohms, independent of gain setting.

2.04 The power amplifier consists of a 5-stage silicon transistor amplifier. The first two stages, Q2 and Q3, are common-emitter, dc-coupled stages stabilized by dc feedback through R18 and R10 to the base of Q2. The third stage, Q4, is a

Fig. 3—KS-20425 L2 Amplifier System—Front View

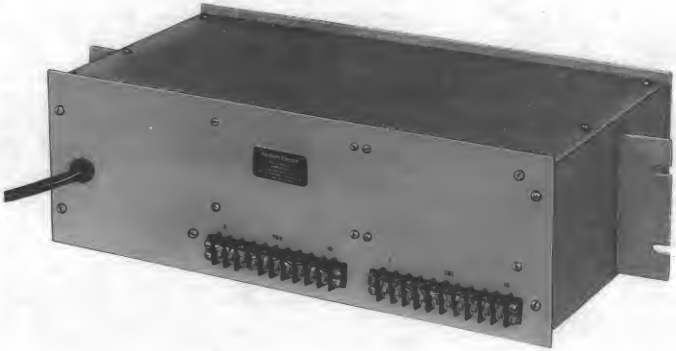

Fig. 4—KS-20425 L2 Amplifier System—Rear View

OPTIONS:

INPUT IMPEDANCE MATCHING	150Ω	Z
	600Ω	Y

S2 SWITCH FUNCTIONS

SWITCH POSITION	FUNCTION
1	5 KHZ-1
2	5 KHZ-2
3	8 KHZ-1
4	8 KHZ-2

NOTES:

1. THE TOTAL RESISTANCE OF THE WIRING USED TO CONNECT TO THE NEAREST DISTRIBUTING RESISTOR PANEL (ED-97065-30) SHOULD NOT EXCEED 0.04 OHMS.
2. THE CONNECTING VU METER SHOULD BE OPERATED IN THE BRIDGING POSITION AND PROVIDE AN INPUT IMPEDANCE OF AT LEAST 7500 OHMS.
3. UNLESS OTHERWISE SPECIFIED; RESISTANCE VALUES ARE IN OHMS, CAPACITANCE VALUES ARE IN MICROFARADS. VALUES PRECEDED BY THE SYMBOLS +(PLUS) OR -(MINUS) ARE IN VOLTS.
4. ALL VOLTAGES ARE MEASURED WITH RESPECT TO COMMON CONNECTION ▽ WITH A METER OF 20,000 OHMS PER VOLT AND WITH NO SIGNAL APPLIED TO AMPLIFIER.

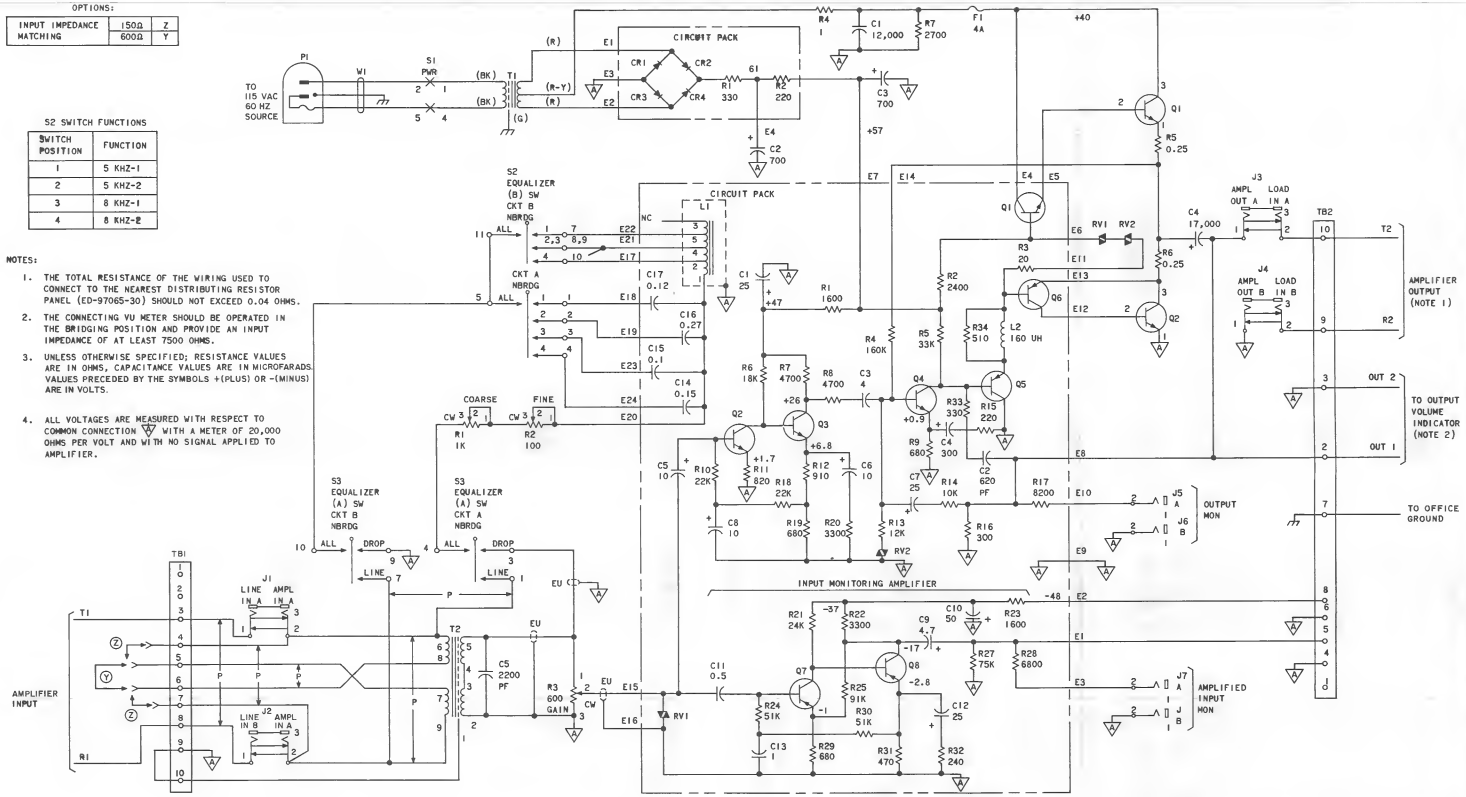

Fig. 5—Schematic of KS-20425 L1 (Manufacture Discontinued) Amplifier System

OPTIONS:

INPUT IMPEDANCE MATCHING	150Ω	Z
	600Ω	Y

S2 SWITCH FUNCTIONS

SWITCH POSITION	FUNCTION
1	5 KHZ-1
2	5 KHZ-2
3	8 KHZ-1
4	8 KHZ-2

NOTES:

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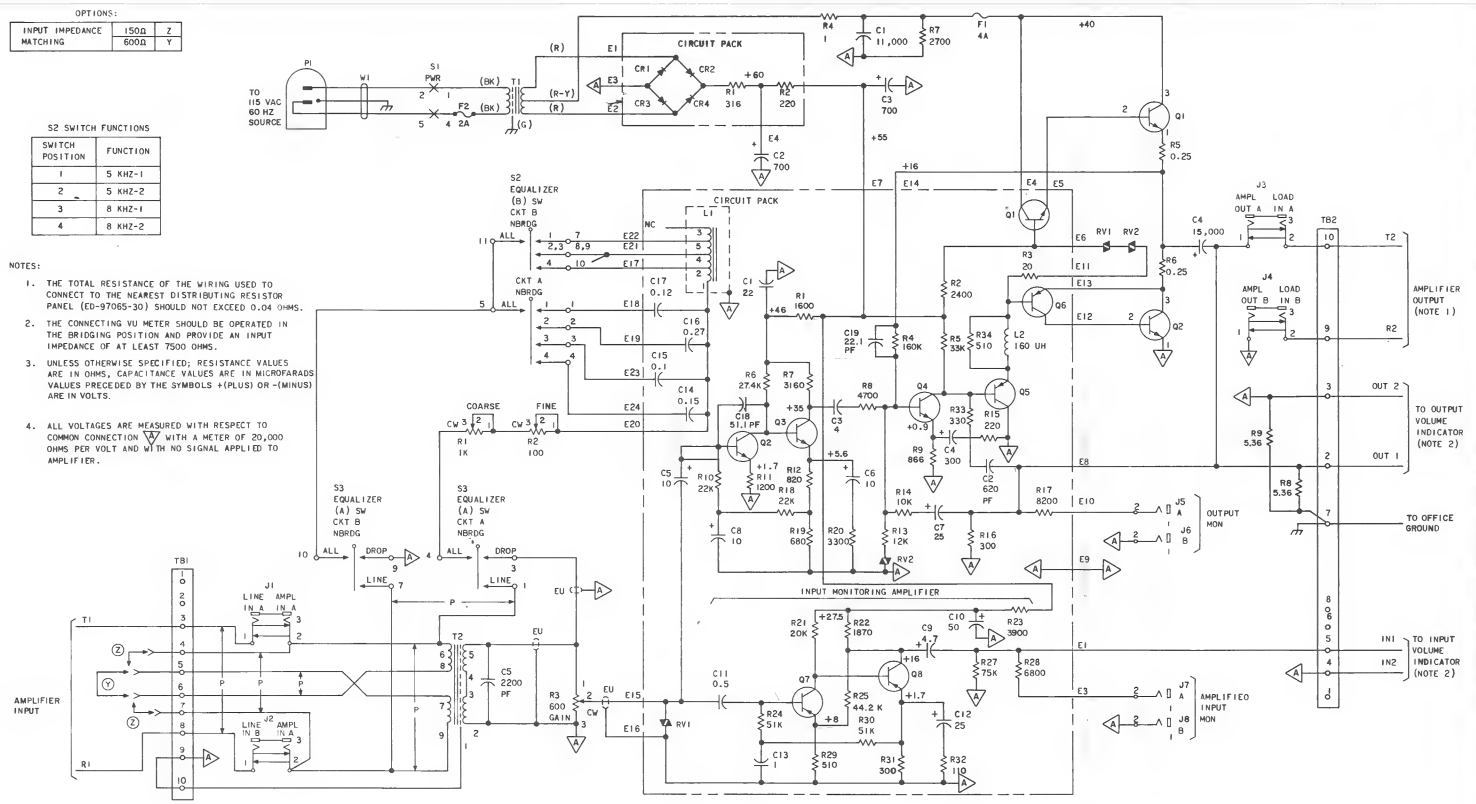

Fig. 6—Schematic of KS-20425 L2 Amplifier System

common-emitter stage and is dc-coupled to the emitter follower, Q5. Q5 is in turn dc-coupled to the quasi-complimentary power output stage consisting of Q1, Q6, power transistors Q1 and Q2. The output signal is derived at the junction of R5 and R6 and coupled to the load through C4 and through the normalled jacks, J3 and J4. The load impedance may be varied from 1.1 ohms to open circuit with no essential change in load voltage. However, maximum power gain of 64.6 dB and maximum undistorted output power of 22.75 watts are obtained with a 1.1-ohm load. These values are for L1 amplifiers with balancing resistors installed and all L2 amplifiers.

2.05 The low output impedance and low distortion characteristics of the power amplifier are obtained primarily by the use of a large amount of ac feedback around the power output stage. The primary feedback path is from the load side of C4 back to the base of Q4 through R14 and C7. A secondary path also exists through R4, but this path is primarily for the purpose of providing dc feedback. High-frequency instability is prevented by two phase correcting networks, one consisting of C2 and R33 and the other of L2 and R34. C18 and C19 were added in the L2 to compensate for the frequency-response characteristics of the transistors used in positions Q2, Q3, and Q4 of the L2 amplifier.

2.06 The quasi-complimentary output stage is biased class B. A small forward bias is provided to reduce crossover distortion. This bias is obtained from the voltage drop across RV1, RV2, and R3 produced by the emitter current of Q5. The two varistors, RV1 and RV2, are physically connected to the heat sinks of Q1 and Q2 to provide thermal bias stability. The dc voltage at the junction of R5 and R6 is thermally stabilized by the dc feedback through R4 and by the varistor RV2 in the base of Q4.

2.07 Signal voltage at the emitter of Q5 drives each half of the output stage alternately into and out of conduction. A positive signal swing drives Q1 and power transistor Q1 into conduction and cuts Q6 and power transistor Q2 off. On negative signal swings, the process is reversed.

2.08 The distribution amplifier is provided with output monitoring jacks and also with terminals for connecting an external VU meter referred to as the OUTPUT VU meter. For normal operation, the OUTPUT VU meter will indicate a voltage reading of +8 VU regardless of the number of subscribers (up to a maximum of 270). The 150-ohm building-out resistance in the distributing resistor panels produces a 6-dB voltage drop which is exactly canceled by the 6-dB correction factor required for 150-ohm circuits. Thus, an OUTPUT VU reading of +8 VU ensures that each subscriber's line is receiving an actual +8 VU. Under these conditions, the output monitoring jacks provide -15 VU to 600-ohm headphones.

2.09 Lightning and short-circuit protections are provided within the distribution amplifier. Lightning protection of the input circuit is provided by the varistor, RV1. The output circuit is inherently protected by its heavy current handling capability, the manner in which it is connected to each subscriber's line through 150 ohms of building-out resistance, its low internal output impedance, and the balancing resistors. Damage by inadvertent short circuitry of the output is prevented by the fuse, F1, the 0.25-ohm resistors, R5 and R6, and by the high current capabilities of the output transistors.

INPUT MONITORING AMPLIFIER CIRCUIT (L2 ONLY)

2.10 The input monitoring amplifier consists of a 2-stage, dc-coupled, transistor amplifier. It employs NPN silicon transistors and two dc feedback paths for good thermal stability. The first of these feedback paths is through R30 and R24 to the base of Q7. The second path is through R25 to the emitter of Q7. The latter also provides ac feedback to reduce the output impedance and ensure good gain stability.

2.11 The input to the amplifier is taken from the gain control, R3, and is identical to the input to the distribution amplifier. The output of the amplifier, terminals 4 and 5 of TB2, is intended for connection to a remote bridging VU meter referred to as the INPUT VU meter. The voltage gain of the amplifier is the same as that of the distribution amplifier, so that INPUT and OUTPUT VU meters will both read +8 VU under normal operating conditions. At this level, the headphone monitoring jacks, J7 and J8, provide -15 VU to 600-ohm headphones. The jacks have been labeled AMPLIFIED INPUT MONITOR to indicate that the signal is derived at the output of the input monitoring amplifier.

POWER SUPPLY CIRCUIT

2.12 Power of 115 Vac is applied to the primary of power transformer T1 through the power switch S1. In the secondary circuit, the ac voltage is converted to two dc voltages. The lower of these two voltages is provided by the full wave rectifier circuit involving CR1 and CR3 and the RC filter consisting of R4 and C1. The higher voltage is provided by the bridge rectifier circuit involving all four rectifiers and the dual RC filter, R1, C2 and R2, C3. The secondary of T1 is a 60-volt center-tapped winding and under no signal conditions produces a 40-Vdc output from the low voltage supply and a 55-Vdc output from the high voltage supply. These voltages decrease with increasing signal power until, at a maximum rated steady state output of 22.75 watts, they fall to approximately 30 volts and 51 volts, respectively.

2.13 Since the quasi-complimentary output stage of the distribution amplifier is biased class B, the 115-Vac input power to T1 will increase with increasing output signal power. The output signal power is maximum when the amplifier is used with a full complement of 270 subscribers. In this case the average 115-volt input power will be approximately 40 watts for typical music programs.

3. CIRCUIT CHARACTERISTICS (TYPICAL)

3.01 The circuit characteristics of the distribution amplifiers are as follows.

(a) ***Resonant Frequencies:*** Resonant frequencies are shown in Table A.

TABLE A

SWITCH POSITION	APPROXIMATE INDUCTANCE (MH)	RESONANT FREQUENCY (KHZ)
5 kHz-1	6	6
5 kHz-2	3	6
8 kHz-1	3	9.6
8 kHz-2	2	9.6

3.02 The circuit characteristics of the L1 with balancing resistors installed and ALL L2 amplifiers are as follows.

(a) ***Maximum Power Gain:*** 64.6 $\pm$1 dB.

(b) ***Maximum Voltage Gain:*** 37 $\pm$1 dB for 600-ohm input strapping; 43 $\pm$1 dB for 150-ohm input strapping.

(c) ***Gain Adjustment:*** Screwdriver operated potentiometer.

(d) ***Frequency Response:*** $\pm$0.5 dB between 35 Hz and 10 kHz.

(e) ***Maximum Power Output:*** 43.6 dBm for a 1.1-ohm load.

(f) ***Harmonic Distortion:*** Less than 0.3 percent between 50 Hz and 10 kHz for load resistances of 1.1 ohms or greater.

(g) ***Temperature Range:*** 0 to +130°F.

(h) ***Output Noise:*** Less than 46 dBrn, 15 kHz flat weighting for 1.1-ohms load.

(i) ***Signal-to-Noise Ratio:*** 88 dB independent of load impedance.

(j) ***Input and Source Impedance:*** 150 or 600 ohms, matched.

(k) ***Output Impedance:*** 0.05 ohm.

(l) ***Load Impedance:*** Variable from 1.1 ohm to open circuit.

(m) ***Input Longitudinal Balance:*** At least 70 dB below 1 kHz. At least 55 dB at 15 kHz.

(n) ***Output Longitudinal Balance:*** At least 55 dB below 1 kHz. At least 45 dB at 10 kHz.

3.03 The circuit characteristics of the input monitoring amplifier are as follows.

(a) ***Voltage Gain:*** 37 $\pm$1 dB for 7500-ohm load impedance.

(b) ***Frequency Response:*** ±1 dB between 35 Hz and 10 kHz.

(c) ***Harmonic Distortion:*** Less than 1 percent between 50 Hz and 10 kHz.

(d) ***Temperature Range:*** 0 to +130°F.

(e) ***Output Signal-to-Noise Ratio:*** Approximately 80 dB.

(f) ***Input Impedance:*** 49 kilohms.

(g) ***Output Impedance:*** 1 kilohm.

(h) ***Load Impedance:*** 7500 ohms (nominal).

3.04 The circuit characteristics of the power supply are as follows.

(a) ***Power Requirements:*** Power requirements are as shown in Table B.

TABLE B

DISTRIBUTION AMPLIFIER OUTPUT TO 1.1-OHM LOAD	115-VAC INPUT POWER
NO SIGNAL	10 Watts
MUSICAL PROGRAM	40 Watts (Average)
43.6 dBm TONE (22.75 Watts)	95 Watts